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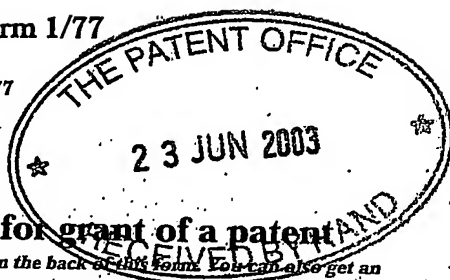
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EAD/20931

2. Patent application number

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Matsushita Electric Industrial Co, Ltd.

1006 Oaza Kadoma

Kadoma-shi

Osaka 571-8501

Japan

a Japanese company

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

591842002

4. Title of the invention

Embedded device with software registry

5. Name of your agent (if you have one)

A A THORNTON & CO

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

235 HIGH HOLBORN  
LONDON WC1V 7LE

Patents ADP number (if you know it)

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Country

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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

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- a) any applicant named in part 3 is not an inventor, or
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Claim(s)	2
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I/We request the grant of a patent on the basis of this application.

Signature *A. A. Thornton & Co*

Date

A. A. Thornton & Co.

23/06/03

12. Name and daytime telephone number of person to contact in the United Kingdom

Elizabeth Ann DAWSON 0207 405 4044

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## Embedded device with software registry

The present invention relates to control devices of the kind that are embedded in electrical and electronic apparatus. The invention has been developed for application to mobile telephones but is equally applicable to a wide range of equipment with embedded devices from vehicles to washing machines.

## Background

Software errors in a high volume commodity product (such as a mobile phone handset) can be very expensive to repair, involving a product recall, software reprogramming, and then re-issue of the product, not to mention such additional items as replacements-under-guarantee and loss of reputation and customer confidence. Clearly, a mechanism is needed where software upgrades and fixes, known as "patches", can be installed, uninstalled and managed on a target device without recall of that target device and consequently with little impact to the user of the device. Additionally, the uses to which such a device can be put vary from user to user, and it may be necessary to install, uninstall and manage new software modules in addition to those already resident on the device.

Once such a mechanism is in place, the patches and updates installed on the handset may be managed, both locally on the handset User Interface (if present) or remotely over a communications link.

It is known for a device with large hard disc memory capacity, such as a personal computer, to have a program registry stored on the hard disc. This registry may include information relating to any programs or software upgrades recently installed on the computer.

Hitherto, when a software modification is required on a mobile telephone (or other device/appliance having an embedded system), for example during a product recall, it would be usual to rewrite the whole of the device software, for example by "reflashing" a flash memory. A separate management system might store information identifying which software versions have been installed on which devices, for example to avoid repetition and to aid future problem analysis.

The present invention provides a control device as defined in annexed claim 1. Preferred features of the device are described in the subsidiary claims. The installed programs may include equipment operating programs as well as universal applications such as calendars and calculators.

An example of a patch registry suitable for use in a control device according to the invention, sometimes called a "target device", will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a block diagram over-view of a patch registry; and

Figure 2 is a more detailed block diagram showing an example of the data structures that may be used in the patch registry.

A device according to the present invention typically consists of a self-contained device having one or more computing components each with processor, memory and non-volatile program storage of limited size. These may not be "self contained" units and processors may share memory space.. The device may also contain network connectivity to enable access to a server system; or facility to allow network connectivity to a server system, and may contain a removable storage device, for example an SD card.

The patch registry will contain information about patch files, installed patches and software updates. A patch file is the means of delivery of one or more patches to the device, and consists of a collection of data which contains information sufficient to allow a device to modify its program memory. A patch file may contain information about one or more patches, each of which may be composed of information about one or more changes to be made to the program memory of the target device. The patch file must be transferred to the target device before any modifications can occur. The patch file is used by a system (e.g. program) resident on the target device.

Some of the characteristics of the device impose particular requirements on the design of the patch registry. These characteristics are:

- Limited memory space both for persistent (i.e. that which remains present over a power off-on cycle) storage of program and configuration information, and also non-persistent (volatile) storage of other information.
- The main persistent storage medium, usually Flash memory, requires specialised processing in order to make modifications to its contents.
- The file system uses memory as its storage medium rather than being disk-based, and in a memory-constrained device this file system will consequently have limited storage capacity.
- The program of each computing element typically runs directly from the persistent storage of the device, unlike larger desktop computing devices that store their programs on a backup store (usually a hard disk) and then load the programs that are desired to be run into volatile (non-persistent) storage during their start up sequence.
- It may not be commercially acceptable that the mobile device be restarted as a consequence of the changes being applied.

The requirements imposed on the design of the patch registry by these characteristics are:

-

- The information stored describing the changes must be particularly detailed, though must at the same time be optimised to consume a minimal amount of storage.
- The Patch system must allow recovery from a power failure during an installation or uninstallation.

The mechanism proposed is extendable to be used for new software installation, for upgrade or bug fixing, or installation of new functionality.

The following describes how information relating to patches is installed in the program storage of a target device. The method of distribution and installation of a patch is not described here, but may use the network connectivity or the removable storage device.

Referring now to Figure 1, the patch registry will include at least status and progress information 1, to be described in more detail below, patch list 2 and a list of unused program storage blocks 3. The patch list 2 will usually contain a list of patch identifiers such as P1, P2 ... etc. Typically, for each patch, the registry will contain a record 20 of information relating to the patch including patch descriptor 21 and a list of changes being effected by the patch, a, b, c etc. For each change, a, b, c etc there will be a change descriptor 23 containing further details of the change. For each unused program storage block n, n+1, n+2, n+3 there is a corresponding information block 31, 32, 33, 34 to be described in more detail below.

In general a patch consists of one or more individual changes to the program memory of a target device, replacing "faulty code" with "repaired" code. Each of these changes is therefore made to non-volatile storage.

The patch system installs patches on the Target Device in two ways. For each change either the faulty program code is overwritten by the repair code, or the

repair code is installed in an unused area of program memory and program flow is directed to this area when required and back to the main program as necessary. In both cases, a record of information about the identity and location of the installed patch is created and maintained consisting of items P1 and 20 to 23 of Figure 1. A list of unused program storage for each processing element may also be manipulated items 3 and 31-34 of Figure 1.

From time to time it may be necessary to uninstall or remove patches from the Target Device. The previously described record of information 2 is used to uninstall the changes and to return any areas of program memory that were used back to the list of unused program storage 3. Once the unused areas have been returned the information about the patch is removed from the Registry.

Lastly, the Server System may interrogate the Target Device to determine what patches are installed and what capacity for further patches is available. This information may also be presented on demand through the user interface of the Target Device (not shown). The information used to respond to such requests is derived from information saved in the Patch Registry.

In all these cases, it is necessary for the Target Device to retain information about the patches installed in it, and to maintain information about the remaining unused program memory. The patch registry is the means by which this information is retained.

An exemplary data structure of the patch registry is shown in more detail in Figure 2. Any suitable storage format such as text, binary, XML may be used and will not be described in detail herein.

Status and progress information block 1 includes two elements, namely element 10 indicating the overall status of the registry, e.g. a counter value implemented at each update, and patch installation status information block 11 containing



Record details of all patches already installed for interrogation locally by management software on the Target Device.

For each completed change, identify the computing component(s) to which the change was applied.

Allow identification of attempts to send duplicate patches perhaps by retaining an ID for each installed patch.

Allow identification of address clashes between any installed patch and a new patch.

Hold information about the unused program storage remaining for each computing element, and allow interrogation of same to facilitate patch installation and removal and for interrogation by the Server System or management software on the Target Device. The unused program storage is typically composed of a number of individual blocks. The Registry lists these in a manner which facilitates efficient searching when installing a new patch.

Record details of patches being installed or uninstalled, to allow recovery after a power failure.

Since the Patch Registry is contained in non-volatile storage, and contains details about the patches installed over a particular version of the software of the target device, it should be noted that the patch registry must be rendered to an empty state when a new version of software is installed on the target device.

Claims:

1. A control device for electrical or electronic equipment, the device having processing means and memory means, the memory means having installed programs executable by the processing means, each program being made up of processing elements at least one of which can be modified or upgraded by the installation of a patch, wherein a part of the memory means is used as a patch registry containing a list of patch descriptor elements.
2. A device as claimed in claim 1 in which the patch registry includes information relating to the progress of the installation of a new patch.
3. A device as claimed in claim 1 or 2 in which the patch registry includes a list of unused program memory blocks for each processor element.
4. A device as claimed in claim 3 in which, on installation of a new patch, unused program memory in the list is used to extend the patch registry to contain information relating to the new patch.
5. A device as claimed in any preceding claim in which each patch descriptor element contains a text description of the patch which can be presented to a user interface.
6. A device as claimed in any preceding claim in which each patch descriptor element contains a list of modified code descriptor elements.
7. A device as claimed in claim 6 in which the modified code descriptor elements identify the processor element to which the patch has been applied.
8. A device as claimed in claim 7 in which the modified code descriptor elements identify the start address of a faulty code block in the processor element.

## Abstract

## Embedded device with software registry

A control device for electrical or electronic equipment, usually embedded, has a patch registry storing details of software fixes or "patches" that have been installed.



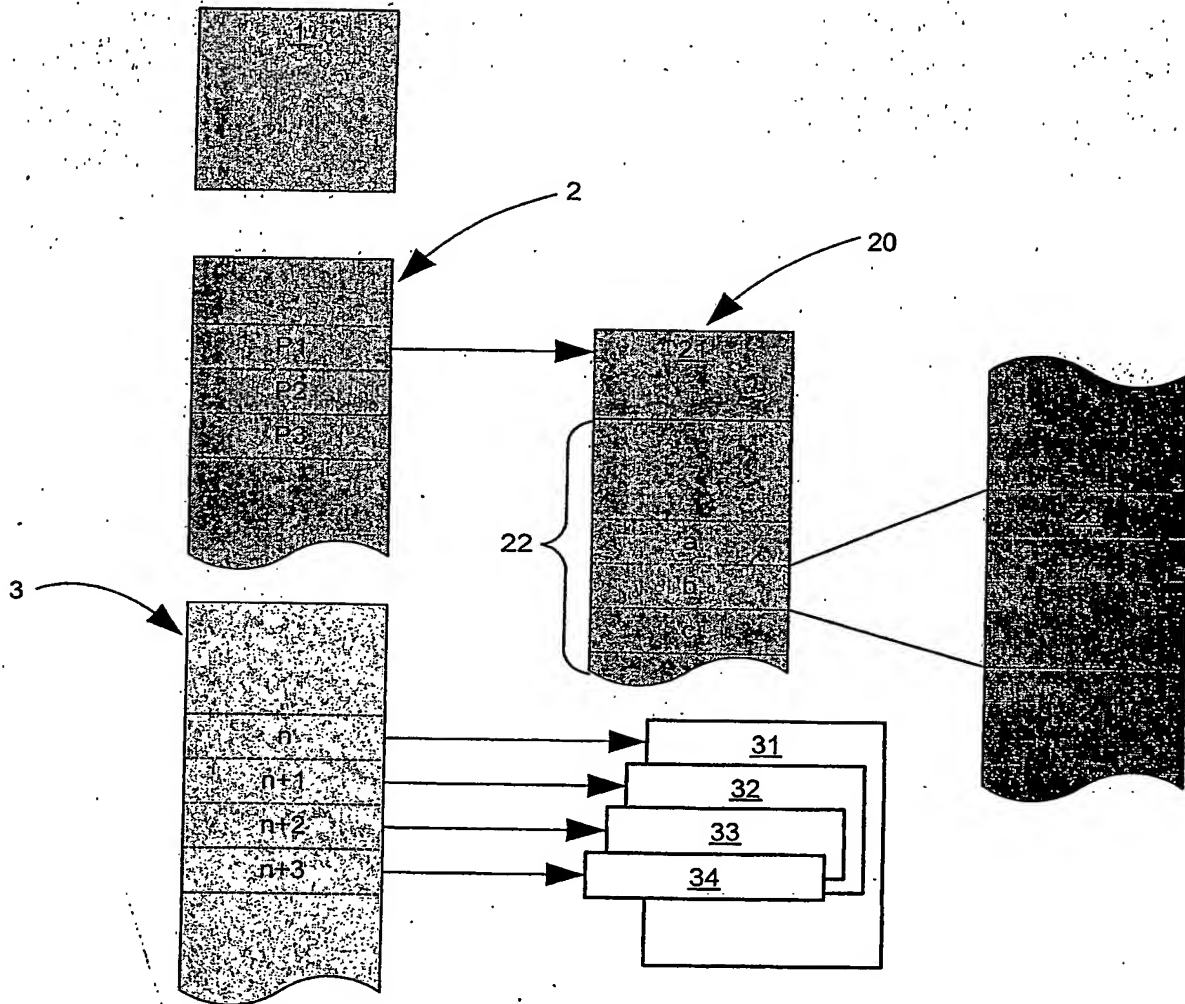


Fig 1

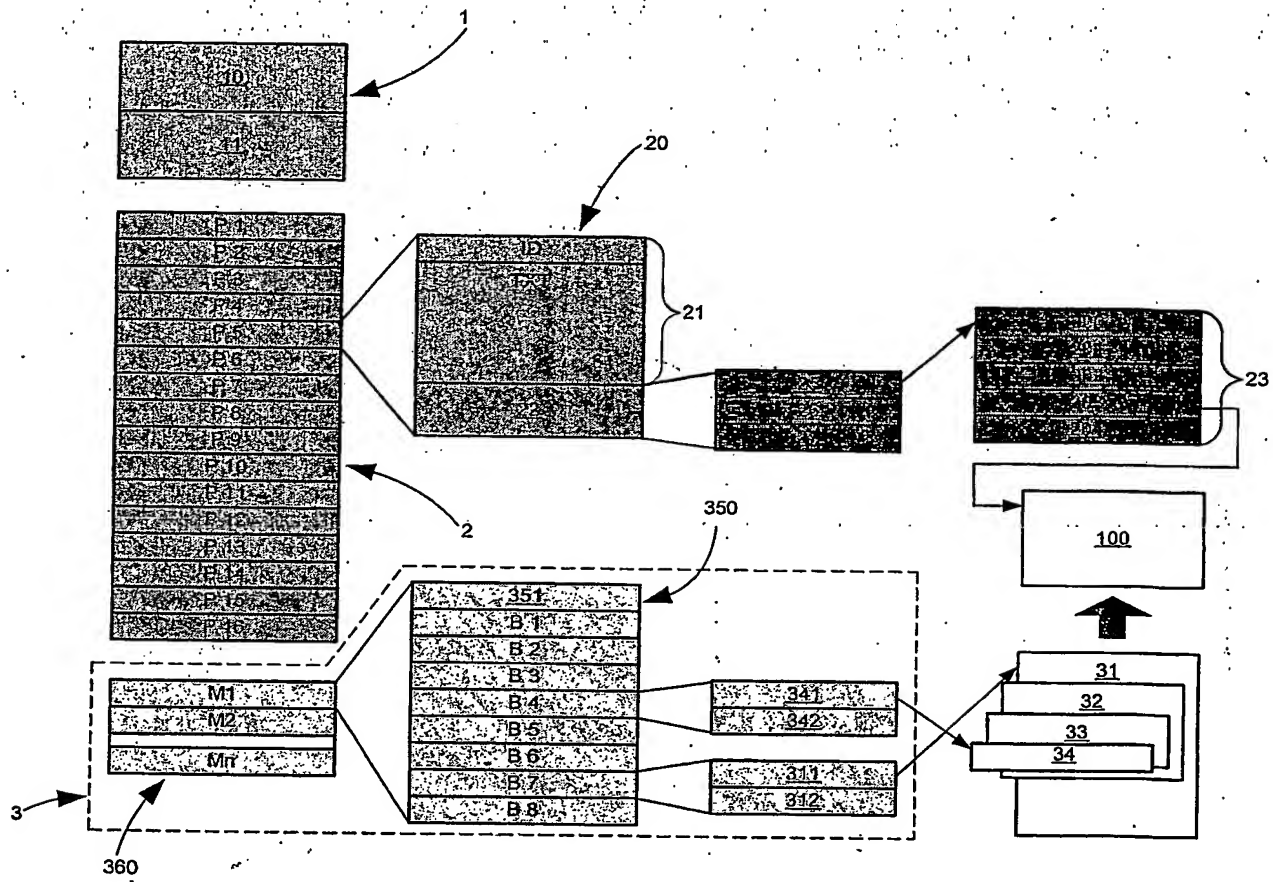
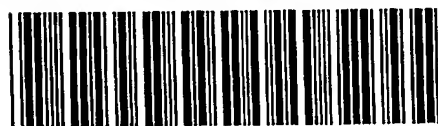


Fig 2

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